Fig. 1

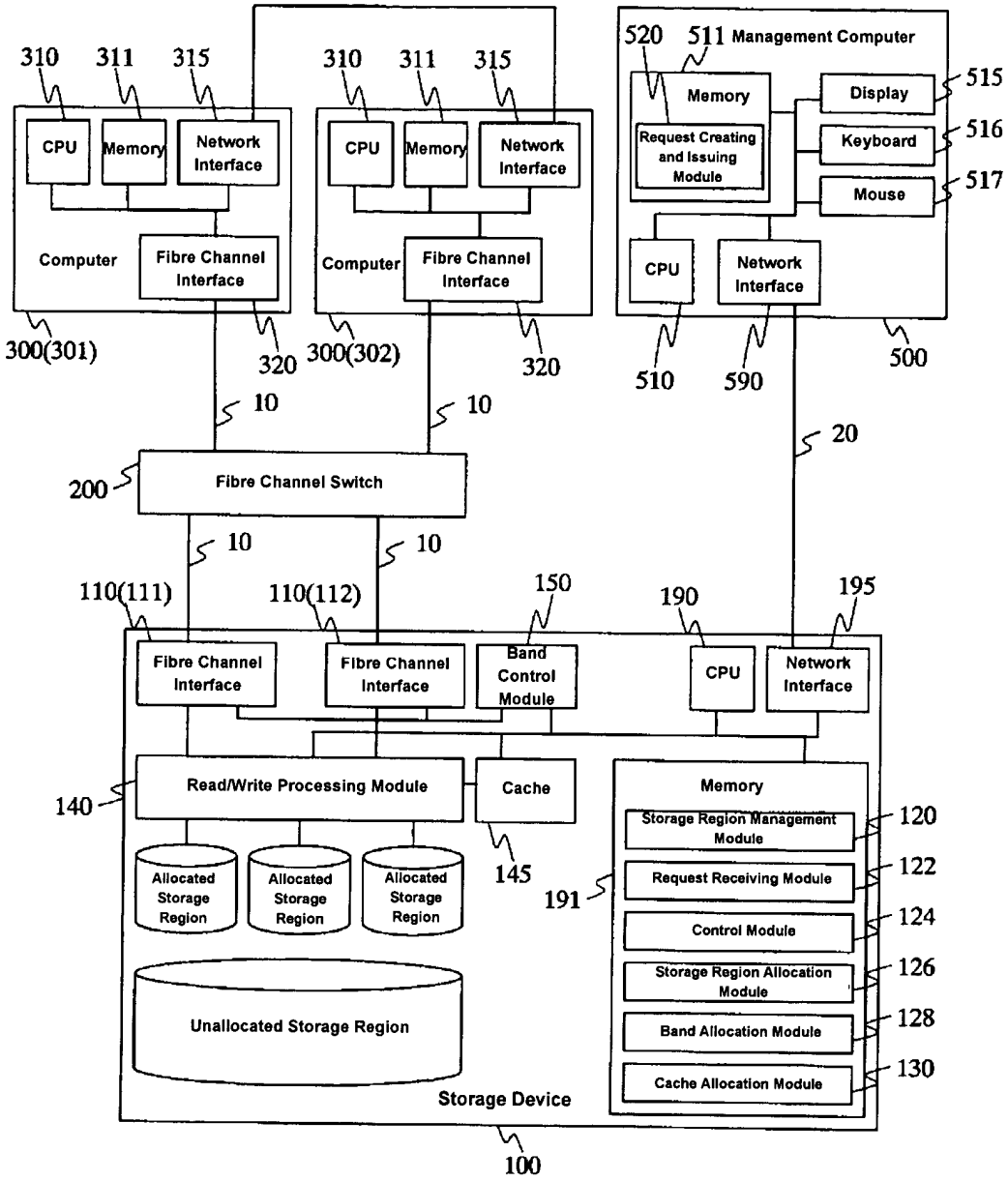

310
311
315
CPU
Memory
Network Interface
Computer
Fibre Channel Interface
300(301)
320
300(302)
520
511 Management Computer
Memory
Request Creating and Issuing Module
Display
Keyboard
Mouse
515
516
517
510
590
500
10
20
200
Fibre Channel Switch
110(111)
110(112)
150
190
195
Band Control Module
140
Read/Write Processing Module
Cache
145
Allocated Storage Region
Unallocated Storage Region
Storage Device
100
191
Storage Region Management Module
Request Receiving Module
Control Module
Storage Region Allocation Module
Band Allocation Module
Cache Allocation Module
120
122
124
126
128
130

Fig. 2

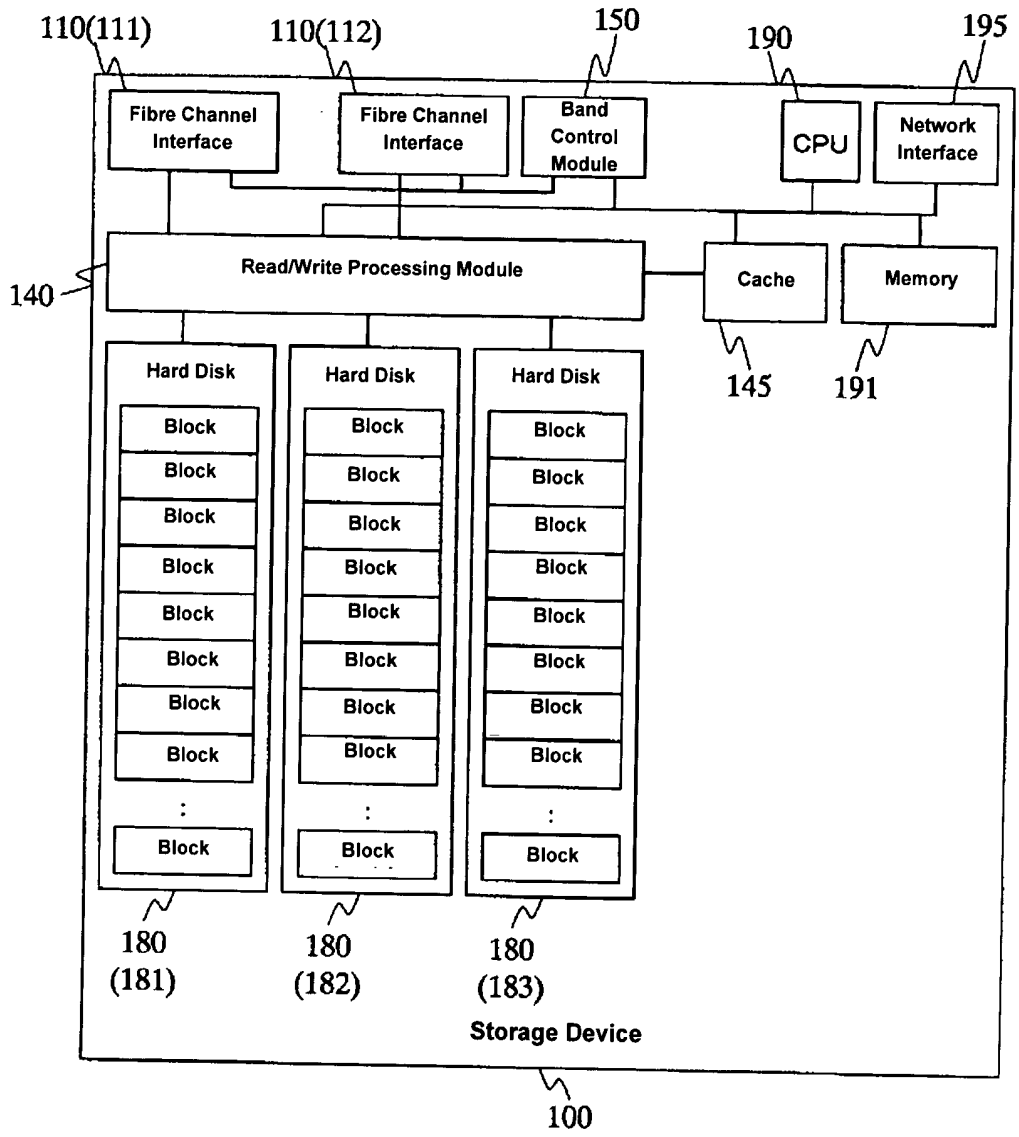

110(111)
110(112)
150
190
195
Fibre Channel Interface
Fibre Channel Interface
Band Control Module
CPU
Network Interface
140
Read/Write Processing Module
Cache
Memory
145
191
Hard Disk
Hard Disk
Hard Disk
Block
180 (181)
180 (182)
180 (183)
Storage Device
100

Fig. 3

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region						
Unallocated Storage Region	181	0~209715199				
	182	0~209715199				
	183	0~209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 4

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region	181	0~41943039	10	10	0	91
Unallocated Storage Region	181	41943040~209715199				
	182	0~209715199				
	183	0~209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 5

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region	181	0~ 41943039	10	10	0	91
	182	0~ 41943039	8	0	0	92
Unallocated Storage Region	181	41943040~ 209715199				
	182	41943040~ 209715199				
	183	0~ 209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 6

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region	181	0~ 41943039	10	10	0	91
	182	0~ 41943039	8	0	0	92
	181	41943040~ 44040191	1	10	10	93
Unallocated Storage Region	181	44040192~ 209715199				
	182	41943040~ 209715199				
	183	0~ 209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 7

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region	181	0~ 41943039	10	10	0	91
	182	0~ 41943039	8	0	0	92
	181	41943040~ 44040191	1	10	10	93
	183	0~ 2097151	10	0	0	94
Unallocated Storage Region	181	44040192~ 209715199				
	182	41943040~ 209715199				
	183	2097152~ 209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 8

121

	Hard Disk No.	LBA Range	Hint			Storage Region No.
			ABW	ARH	ALH	
Allocated Storage Region	182	0~ 41943039	8	0	0	92
	181	41943040~ 44040191	1	10	10	93
	183	0~ 2097151	10	0	0	94
Unallocated Storage Region	181	44040192~ 209715199				
	182	41943040~ 209715199				
	183	0~ 209715199				

ABW: Access Bandwidth Weight
ARH: Access Randomness Hint
ALH: Access Latency Hint

Fig. 9

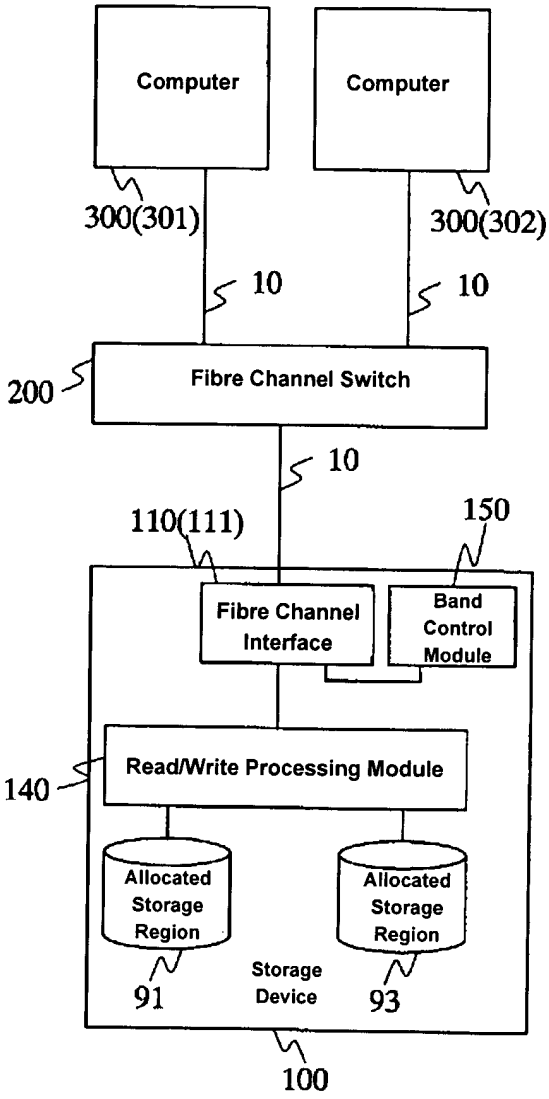

Computer
Computer
300(301)
300(302)
10
10
200
Fibre Channel Switch
10
110(111)
150
Fibre Channel Interface
Band Control Module
140
Read/Write Processing Module
Allocated Storage Region
Allocated Storage Region
91
Storage Device
93
100

Fig. 10

141

FC Interface No.	Storage Region No.	WWN of Accessible Computer	Access Ratio (Band)
111			
112			

Fig. 11

141

FC Interface No.	Storage Region No.	WWN of Accessible Computer	Access Ratio (Band)
111	91	301	80%
112			

Fig. 12

141

FC Interface No.	Storage Region No.	WWN of Accessible Computer	Access Ratio (Band)
111	91	301	80%
112	92	302	60%

Fig. 13

141

FC Interface No.	Storage Region No.	WWN of Accessible Computer	Access Ratio (Band)
111	91	301	80%
	93	302	10%
112	92	302	60%

Fig. 14

141

FC Interface No.	Storage Region No.	WWN of Accessible Computer	Access Ratio (Band)
111	93	302	10%
112	92	302	60%

Fig. 15 (A)

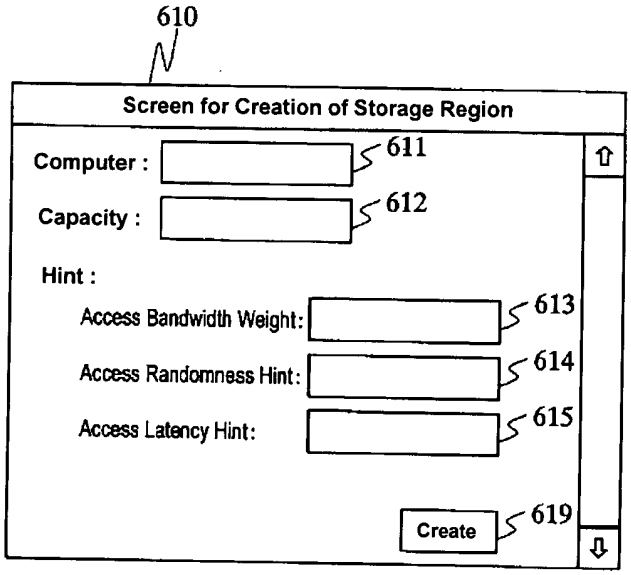


Fig. 15 (B)

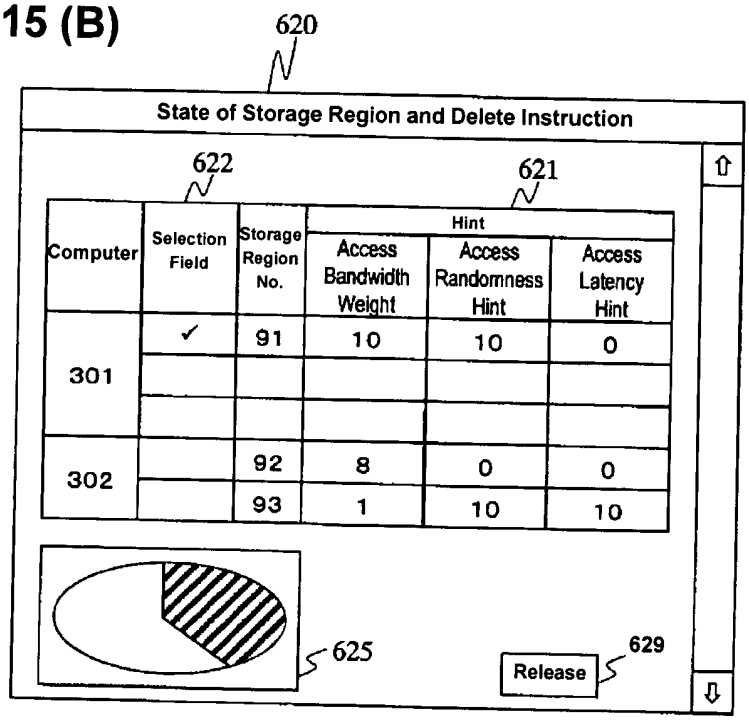


Fig. 16 (A)

129

Access Bandwidth Weight	Parameter to be set for Band Control Module
0	5%
1	10%
2	15%
3	20%
4	25%
5	30%
6	40%
7	50%
8	60%
9	70%
10	80%

Fig. 16 (B)

131

AccessRandomness Hint / AccessLatencyHint	Dedicated Cache Allocation Rate	
	0~5	6~10
0	0%	0%
1	1%	10%
2	2%	20%
3	3%	30%
4	4%	40%
5	5%	50%
6	6%	60%
7	7%	70%
8	8%	80%
9	9%	90%
10	10%	100%

Fig. 17 (A)

139

	Storage Region No.	Cache Capacity
Allocated Cache		
Unallocated Cache		4GB

Fig. 17 (B)

139

	Storage Region No.	Cache Capacity
Allocated Cache	93	1GB
Unallocated Cache		3GB

Fig. 18

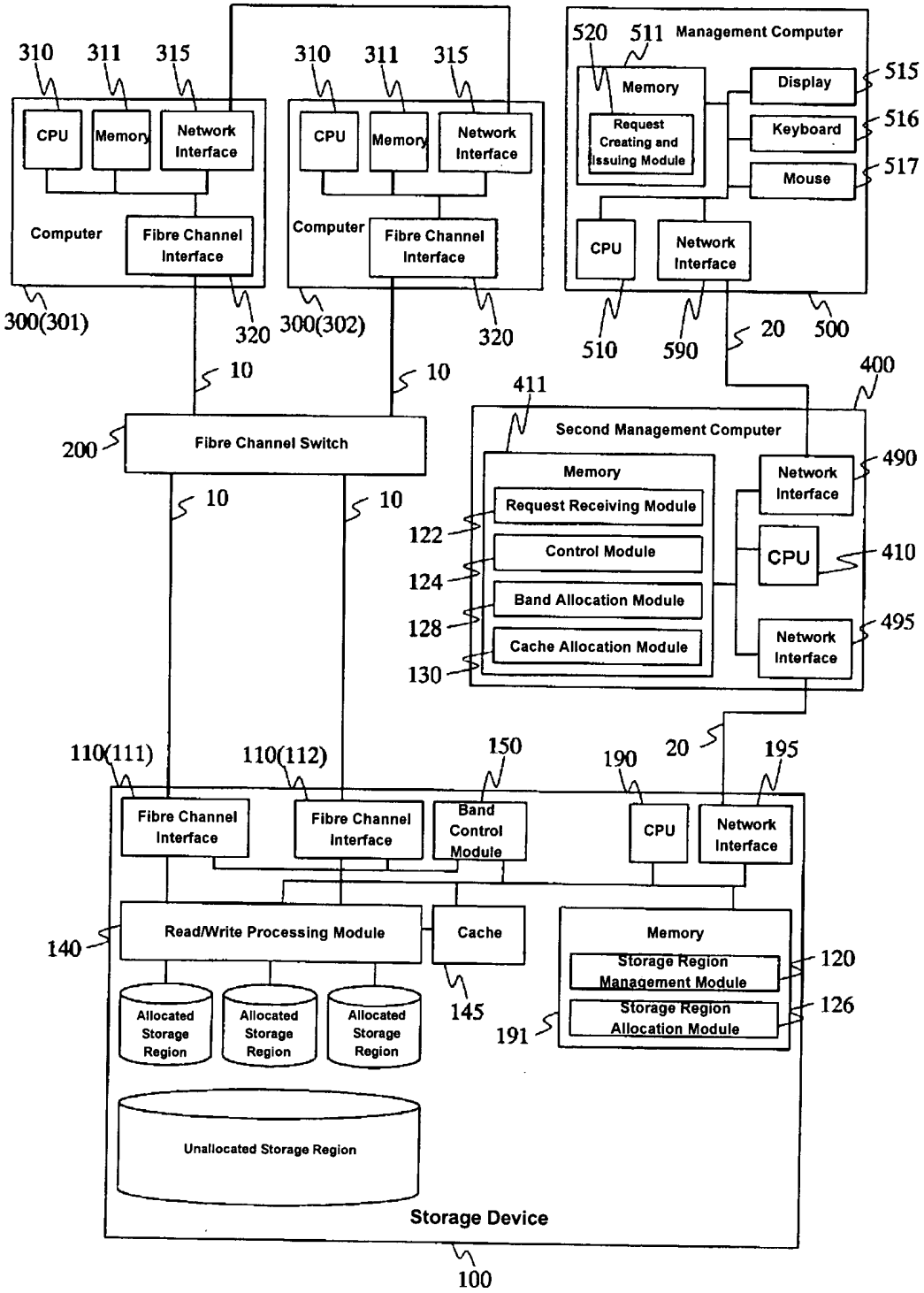

310
311
315
CPU
Memory
Network Interface
Computer
Fibre Channel Interface
300(301)
320
300(302)
520
511
Management Computer
Memory
Request Creating and Issuing Module
Display
Keyboard
Mouse
515
516
517
510
590
20
500
400
411
Second Management Computer
490
Request Receiving Module
Control Module
Band Allocation Module
Cache Allocation Module
122
124
128
130
410
495
10
200
Fibre Channel Switch
110(111)
110(112)
150
190
195
Band Control Module
Read/Write Processing Module
Cache
140
145
120
126
191
Storage Region Management Module
Storage Region Allocation Module
Allocated Storage Region
Unallocated Storage Region
Storage Device
100

Fig. 19

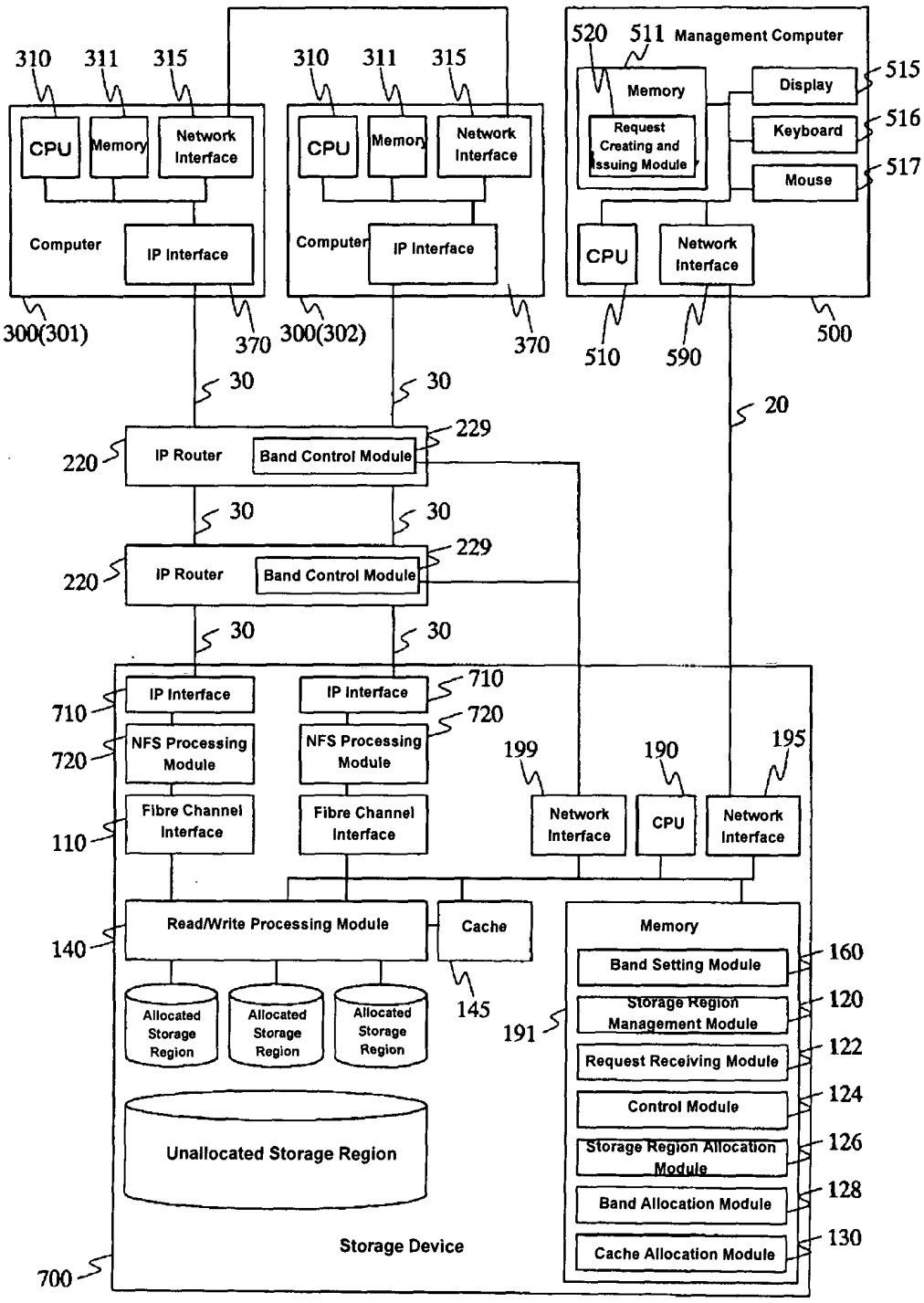

310
311
315
CPU
Memory
Network Interface
Computer
IP Interface
300(301)
370
300(302)
520
511
Management Computer
Memory
Request Creating and Issuing Module
Display
Keyboard
Mouse
515
516
517
510
590
500
30
20
220
IP Router
Band Control Module
229
710
720
NFS Processing Module
Fibre Channel Interface
110
199
190
195
140
Read/Write Processing Module
Cache
145
Allocated Storage Region
Unallocated Storage Region
Storage Device
700
191
160
120
122
124
126
128
130
Band Setting Module
Storage Region Management Module
Request Receiving Module
Control Module
Storage Region Allocation Module
Band Allocation Module
Cache Allocation Module

Fig. 20

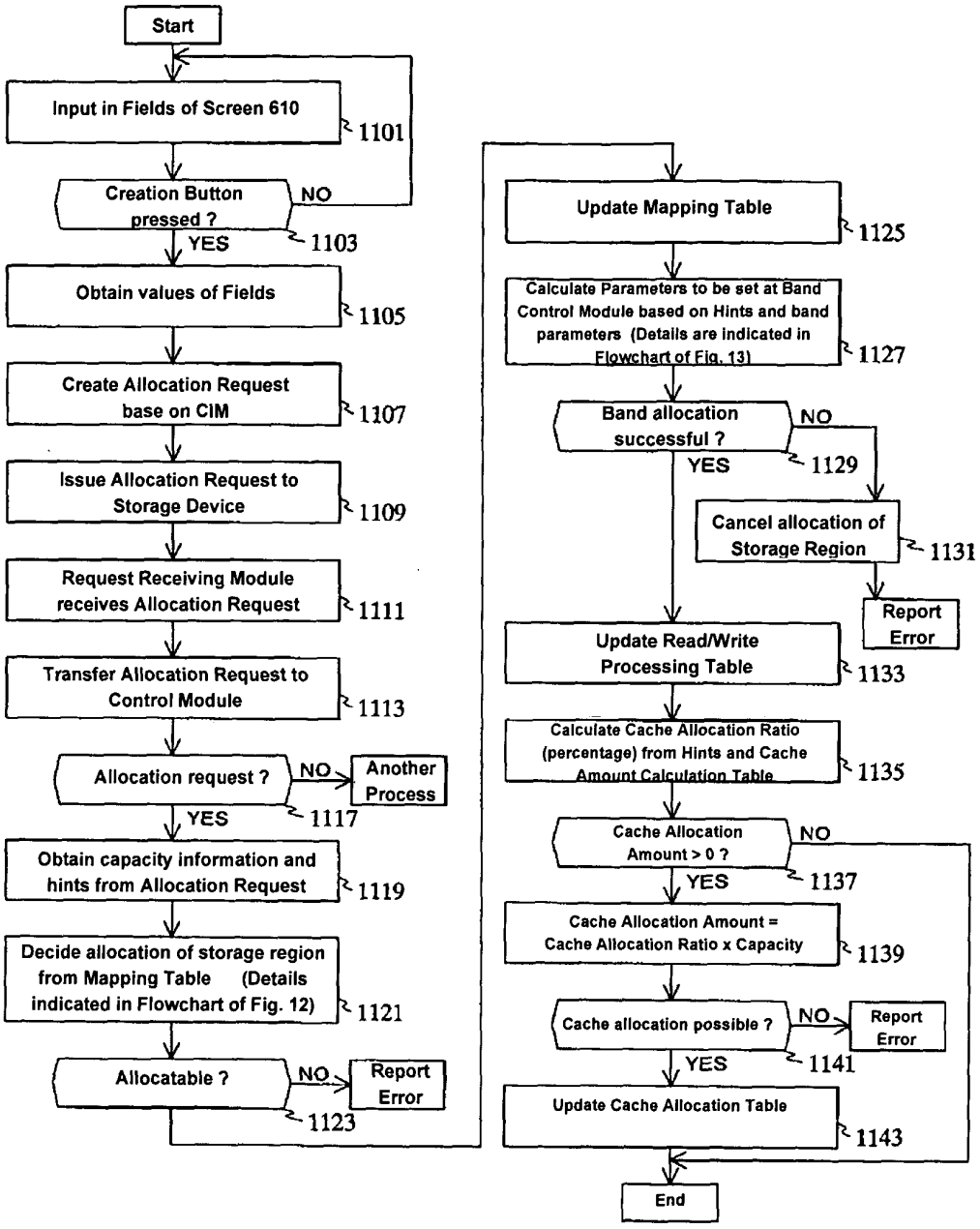

Start
Input in Fields of Screen 610
1101
Creation Button pressed ?
NO
YES
1103
Obtain values of Fields
1105
Create Allocation Request base on CIM
1107
Issue Allocation Request to Storage Device
1109
Request Receiving Module receives Allocation Request
1111
Transfer Allocation Request to Control Module
1113
Allocation request ?
NO
Another Process
YES
1117
Obtain capacity information and hints from Allocation Request
1119
Decide allocation of storage region from Mapping Table (Details indicated in Flowchart of Fig. 12)
1121
Allocatable ?
NO
Report Error
1123
Update Mapping Table
1125
Calculate Parameters to be set at Band Control Module based on Hints and band parameters (Details are indicated in Flowchart of Fig. 13)
1127
Band allocation successful ?
NO
YES
1129
Cancel allocation of Storage Region
1131
Report Error
Update Read/Write Processing Table
1133
Calculate Cache Allocation Ratio (percentage) from Hints and Cache Amount Calculation Table
1135
Cache Allocation Amount > 0 ?
NO
YES
1137
Cache Allocation Amount = Cache Allocation Ratio x Capacity
1139
Cache allocation possible ?
NO
Report Error
YES
1141
Update Cache Allocation Table
1143
End

Fig. 21

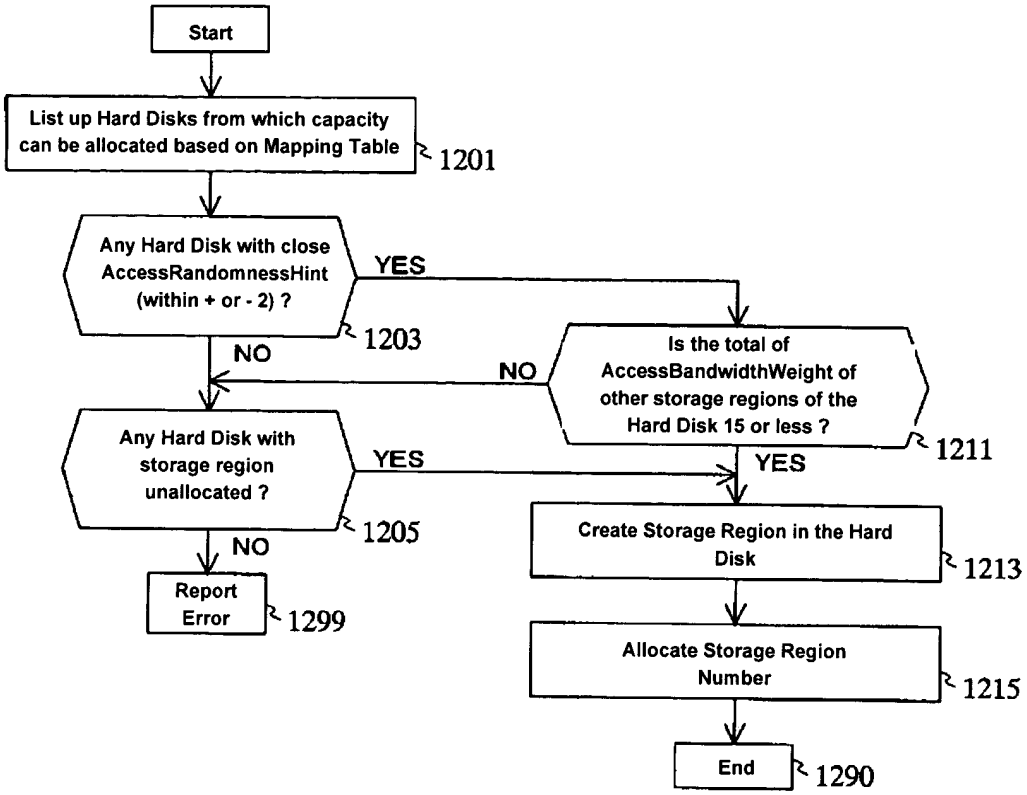

Start
List up Hard Disks from which capacity can be allocated based on Mapping Table
1201
Any Hard Disk with close AccessRandomnessHint (within + or - 2) ?
1203
YES
NO
Is the total of AccessBandwidthWeight of other storage regions of the Hard Disk 15 or less ?
1211
NO
YES
Any Hard Disk with storage region unallocated ?
1205
YES
NO
Report Error
1299
Create Storage Region in the Hard Disk
1213
Allocate Storage Region Number
1215
End
1290

Fig. 22

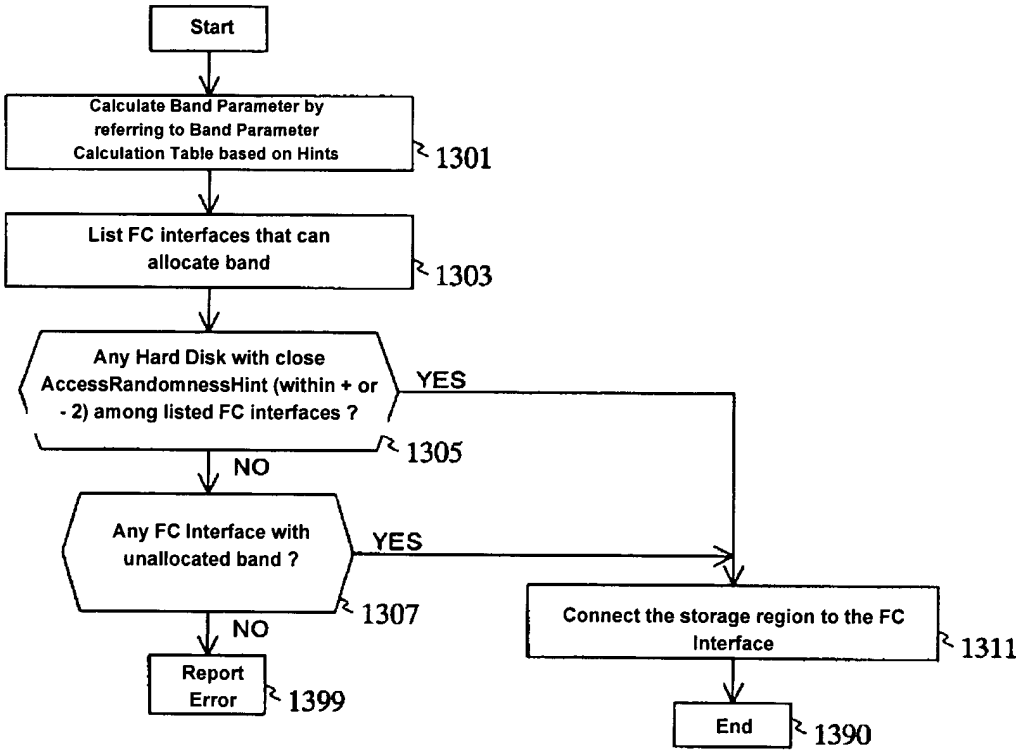

Start
Calculate Band Parameter by referring to Band Parameter Calculation Table based on Hints
1301
List FC interfaces that can allocate band
1303
Any Hard Disk with close AccessRandomnessHint (within + or - 2) among listed FC interfaces ?
YES
1305
NO
Any FC Interface with unallocated band ?
YES
1307
NO
Report Error
1399
Connect the storage region to the FC Interface
1311
End
1390

Fig. 23

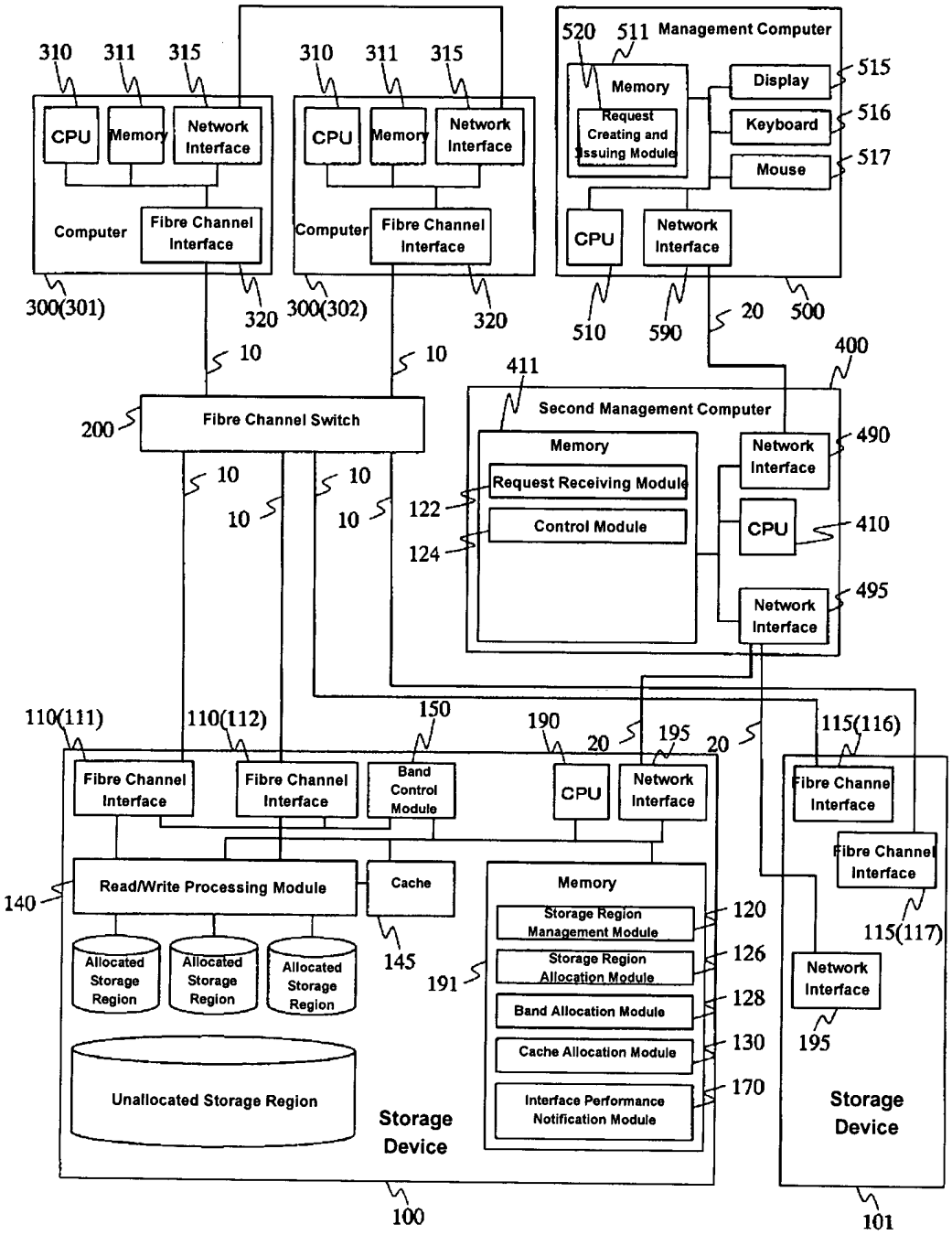

310
311
315
CPU
Memory
Network Interface
Computer
Fibre Channel Interface
300(301)
320
300(302)
520
511
Management Computer
Memory
Request Creating and Issuing Module
Display
515
Keyboard
516
Mouse
517
510
590
20
500
400
411
Second Management Computer
490
Request Receiving Module
122
Control Module
124
410
495
200
Fibre Channel Switch
10
110(111)
110(112)
150
190
195
115(116)
Band Control Module
Fibre Channel Interface
115(117)
140
Read/Write Processing Module
Cache
145
191
120
126
128
130
170
Storage Region Management Module
Storage Region Allocation Module
Band Allocation Module
Cache Allocation Module
Interface Performance Notification Module
Allocated Storage Region
Unallocated Storage Region
Storage Device
100
101

Fig. 24 (A)

171

FC Interface No.	Performance
111	1Gbps
112	1Gbps

Fig. 24 (B)

172

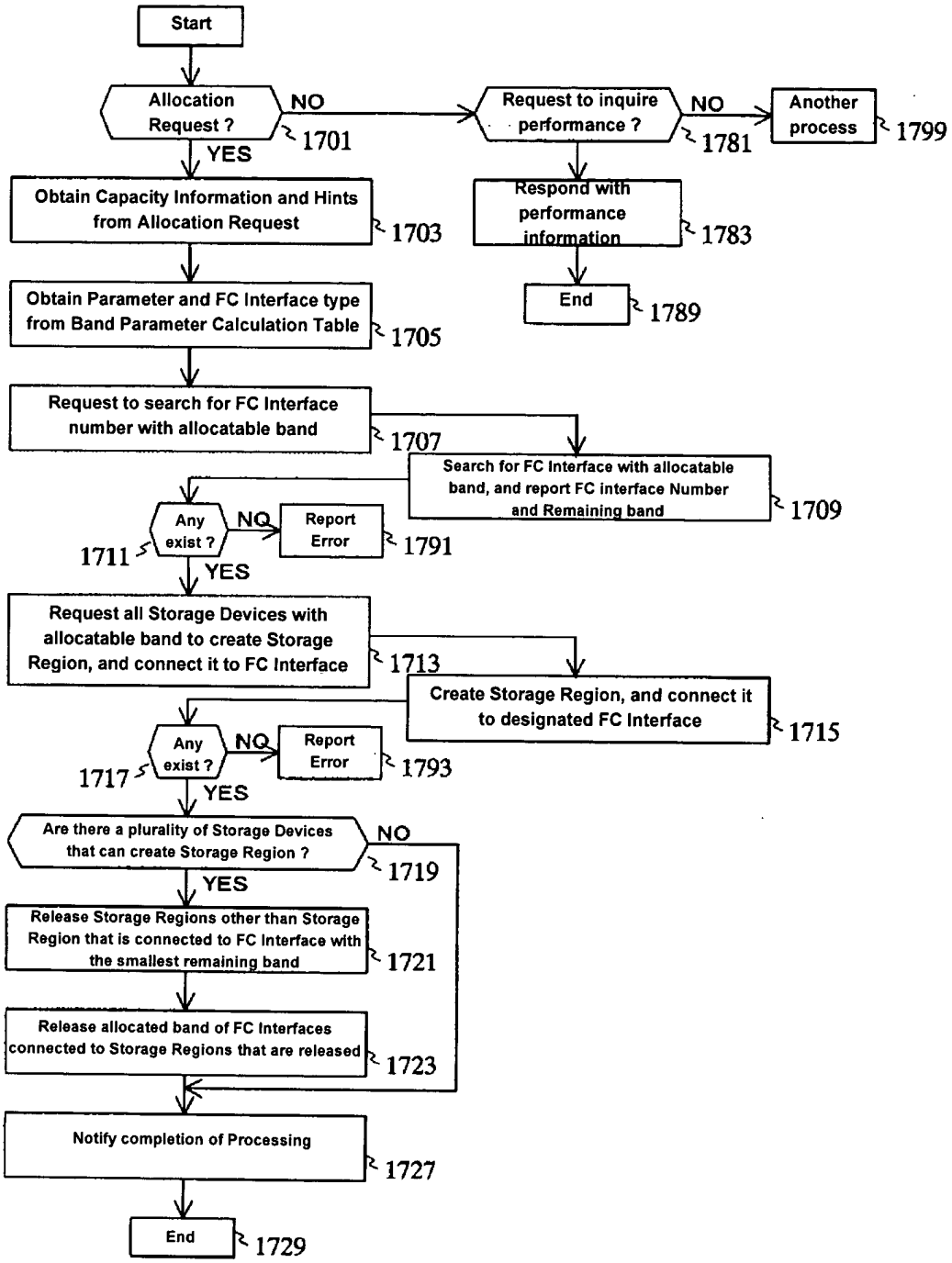
FC Interface No.	Performance
116	2Gbps
117	2Gbps

Fig. 25

129

Access Bandwidth Weight	Parameter to be set at Band Control Module	
	1Gbps	2Gbps
0	10%	5%
1	20%	10%
2	30%	15%
3	40%	20%
4	50%	25%
5	60%	30%
6	80%	40%
7	*	50%
8	*	60%
9	*	70%
10	*	80%

Fig. 26


Start
Allocation Request ?
NO
1701
YES
Request to inquire performance ?
NO
1781
Another process
1799
Obtain Capacity Information and Hints from Allocation Request
1703
Respond with performance information
1783
End
1789
Obtain Parameter and FC Interface type from Band Parameter Calculation Table
1705
Request to search for FC Interface number with allocatable band
1707
Search for FC Interface with allocatable band, and report FC interface Number and Remaining band
1709
Any exist ?
1711
NO
Report Error
1791
YES
Request all Storage Devices with allocatable band to create Storage Region, and connect it to FC Interface
1713
Create Storage Region, and connect it to designated FC Interface
1715
Any exist ?
1717
NO
Report Error
1793
YES
Are there a plurality of Storage Devices that can create Storage Region ?
NO
1719
YES
Release Storage Regions other than Storage Region that is connected to FC Interface with the smallest remaining band
1721
Release allocated band of FC Interfaces connected to Storage Regions that are released
1723
Notify completion of Processing
1727
End
1729